

Fast Growing Forests Soil Survey Standards

M. Streit, S. King and J. Glaab

Fast Growing Forests Group, Ontario Ministry of Natural Resources

© 1987 Government of Ontario



Ministry of
Natural
Resources



Forest Resource Development Agreement

Canada

© Ontario

Acknowledgement: District Forests Staff of the Eastern Region, in particular Carleton Place District, participated and greatly assisted in the development of these standards. Dr. Ed White, State University of New York, at Syracuse, reviewed the standards and contributed valuable comments and suggestions.

TABLE OF CONTENTS

TITLE	PAGE
INTRODUCTION	1
PROCEDURE	2
HORIZONS	8
Horizon Depth	8
FOREST HUMUS FORM	9
ORGANIC SOILS	12
TEXTURE	13
Field Identification of Soil Texture	13
Identifying Characteristics of Texture Classes	15
STRUCTURE	21
MOTTLES AND GLEY COLOURS	22
SOIL MOISTURE	24
ROOTS	31
COARSE FRAGMENTS	32
FREE CARBONATES	32
FINAL SOIL SURVEY REPORT	34
EQUIPMENT	37
REFERENCES	38

FIGURES

TITLE	PAGE
FIGURE 1: Soil Profile Description Sheet	5
FIGURE 2: Profile Feature Symbols	6
FIGURE 3: Computerized Compartment File	7
FIGURE 4: Horizon Depth Measurements	8
FIGURE 5: Humus Form Classification	11
FIGURE 6: Soil Texture Key	19
FIGURE 7: Soil Texture Triangle	20
FIGURE 8: A Guide to Assessing Soil Moisture	25
FIGURE 9: Soil Moisture Regime (Deep Mineral Soils)	26
FIGURE 10: Soil Drainage (Deep Mineral Soils)	27
FIGURE 11: Assessment of Family Particle Size	28
FIGURE 12: Assessment of Effective Texture in Stratified Mineral Soils .	29
FIGURE 13: Soil Moisture Regime and Drainage (Shallow Mineral Soils) .	30
FIGURE 14: Area Percentage Chart	33
FIGURE 15: Map Symbols	35

INTRODUCTION

The classification of soil types provides valuable information for the allocation of nursery stock and the planning of forest management operations. Although soil type description is already a part of Eastern Region's forest management program, each district has been responsible for implementing its own evaluation procedure. In order to standardize soil type descriptions, the following soil survey standards will be used for all conifer planting sites throughout the Eastern Region.

The purpose of creating a standardized soil survey is to ensure that all staff have access to the same quality of information when allocating planting stock. In particular, as genetically-improved nursery stock becomes available, it will be allocated to the most productive sites. The documentation of soil attributes will also provide information which can be used to analyze the relationships between tree species' growth patterns and soil variables.

PROCEDURE

Preliminary Mapping

- A 1:10 000 preliminary map is made of the site based on aerial photographs and maps.
- Initial soil type delineations are sketched on the map according to drainage, vegetation, and topographic differences apparent on the aerial photographs.
- Where applicable, agricultural soil surveys may be used to provide initial soil type information, but they are not a substitute for on-site sampling.

Initial Soil Sampling

- Once on site, the surveyor must first visually assess potential soil types by evaluating site variability (drainage, vegetation, topography).
- Small sampling pits or auger holes, deep enough to identify and texture the B horizon, are used to determine soil types (defined by texture, drainage, depth and rockiness) and boundaries.
- Soil sampling is carried out both within soil types and along each soil type boundary.
- The required number of sampling pits will depend upon site variability; however, a minimum sampling intensity of approximately one sampling pit per 1/2 ha is recommended.
- This information is used to refine the preliminary map.

Soil Pit Preparation

- Soil types greater than 1/2 ha in area will require a soil pit deep enough to identify and describe soil attributes down to the C horizon (approximately 80 - 100 cm deep).
- Deeper sampling may be required to assess the soil moisture regime (see page 24) on coarse textured soils (see Figure 9). A soil auger is an effective tool for obtaining deep samples.
- The pit should be situated in an area representative of the associated soil type (e.g., not located near a soil type boundary) and the general vegetation distribution.
- Coarse fragments should be left on the pit face to facilitate accurate estimates of coarse fragment percentages.
- The pit face should be situated to receive the maximum amount of sunlight and should be at least 60 cm across.

Profile Description

- For each soil type a profile description, based on the soil attributes of the A, B, and C horizons, is completed on a standardized profile description sheet (see Figure 1).
- A sketch of the soil pit is made to illustrate the profile features. Profile feature symbols are illustrated in Figure 2.
- Under the "COMMENTS" section of the Profile Description sheet the vegetation, topography and physical features of the soil type are documented. Under the final subheading of this section entitled "Others"

any features having an influence on species allocation, drainage, access or management operations are recorded. Some examples include:

- presence and depth of compacted layers;
- horizontal movement of soil water (i.e., does the soil water move horizontally or is it relatively stagnant);
- site history (e.g., abandoned field);
- artificial drainage systems;
- flooding due to beaver activity;
- site preparation which has already occurred.

The Final Report

- A 1:10 000 soils map is prepared based on the preliminary map of the site (see page 34 - Final Survey Report).
- Copies of the soils maps and profile description sheets are entered into computerized compartment files (see Figure 3).

PIT #:

SOIL TYPE:

SURVEYORS:

PROPERTY LOCATION:

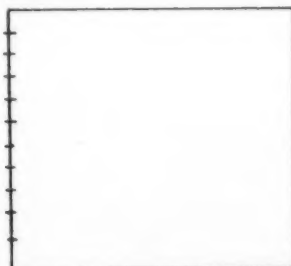
DATE:

OWNER:

AGRICULTURAL SOIL DESIGNATION:

HORIZON				
DEPTH (cm)				
DEPTH OF ORGANIC LAYER (excluding Ah) (cm):	HUMUS FORM: Mull Moder Mor Peaty Mor ORGANIC SOILS: Depth (cm): Of: Om: Oh:			
TEXTURE				
STRUCTURE	Stless Mod Well	Stless Mod Well	Stless Mod Well	Stless Mod Well
DEPTH TO MOTTLES (cm)	Distinct:		Prominent:	
DEPTH TO GLEY LAYER (cm):				
DRAINAGE CLASS	V Rapid	Rapid	Well	Mod Well Imperfect Poorly V Poorly
MOISTURE REGIME	Dry	Mod Dry	Mod Fresh	Fresh Very Fresh
	Mod Moist	Moist	Very Moist	Mod Wet Wet Very Wet
ROOTS:	None	None	None	None
Abundance (#)	<3 3-25 >25	<3 3-25 >25	<3 3-25 >25	<3 3-25 >25
Diameter (mm)	<2 2-5 >5	<2 2-5 >5	<2 2-5 >5	<2 2-5 >5
MAJOR SPECIES:				
MAXIMUM ROOTING DEPTH (cm):				
COARSE FRAGMENTS:	None	None	None	None
Abundance (%)	1-20 20-35 35-50 >50	1-20 20-35 35-50 >50	1-20 20-35 35-50 >50	1-20 20-35 35-50 >50
Size (cm)	.2-7.5 7.5-25 >25	.2-7.5 7.5-25 >25	.2-7.5 7.5-25 >25	.2-7.5 7.5-25 >25
SURFACE ABUNDANCE OF EXPOSED BEDROCK (%):				
DEPTH TO FREE CARBONATES (cm):				

PROFILE DIAGRAM

Depth
(cm)

COMMENTS

Vegetation:

Topography:

Physical Features:

Others:

Figure 1 Soil Profile Description Sheet

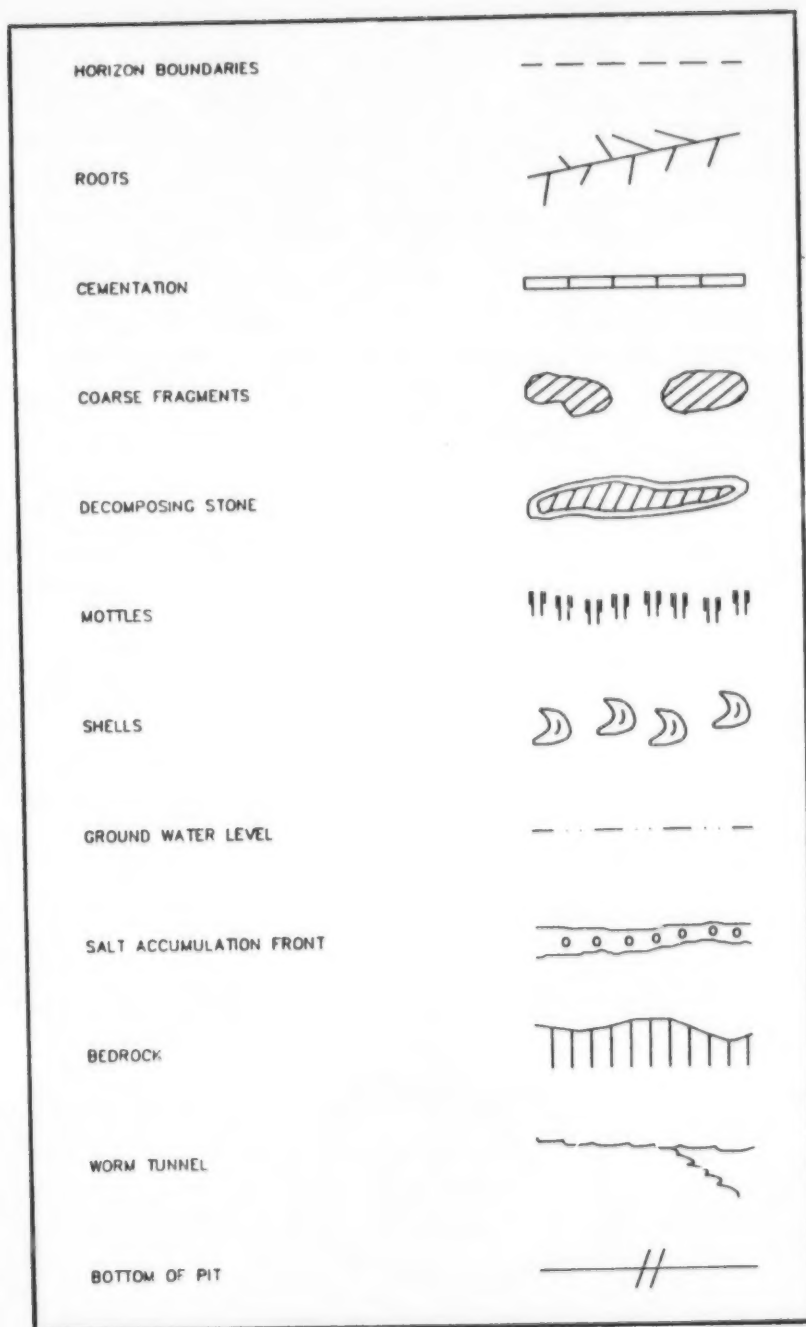


Figure 2 Profile Feature Symbols

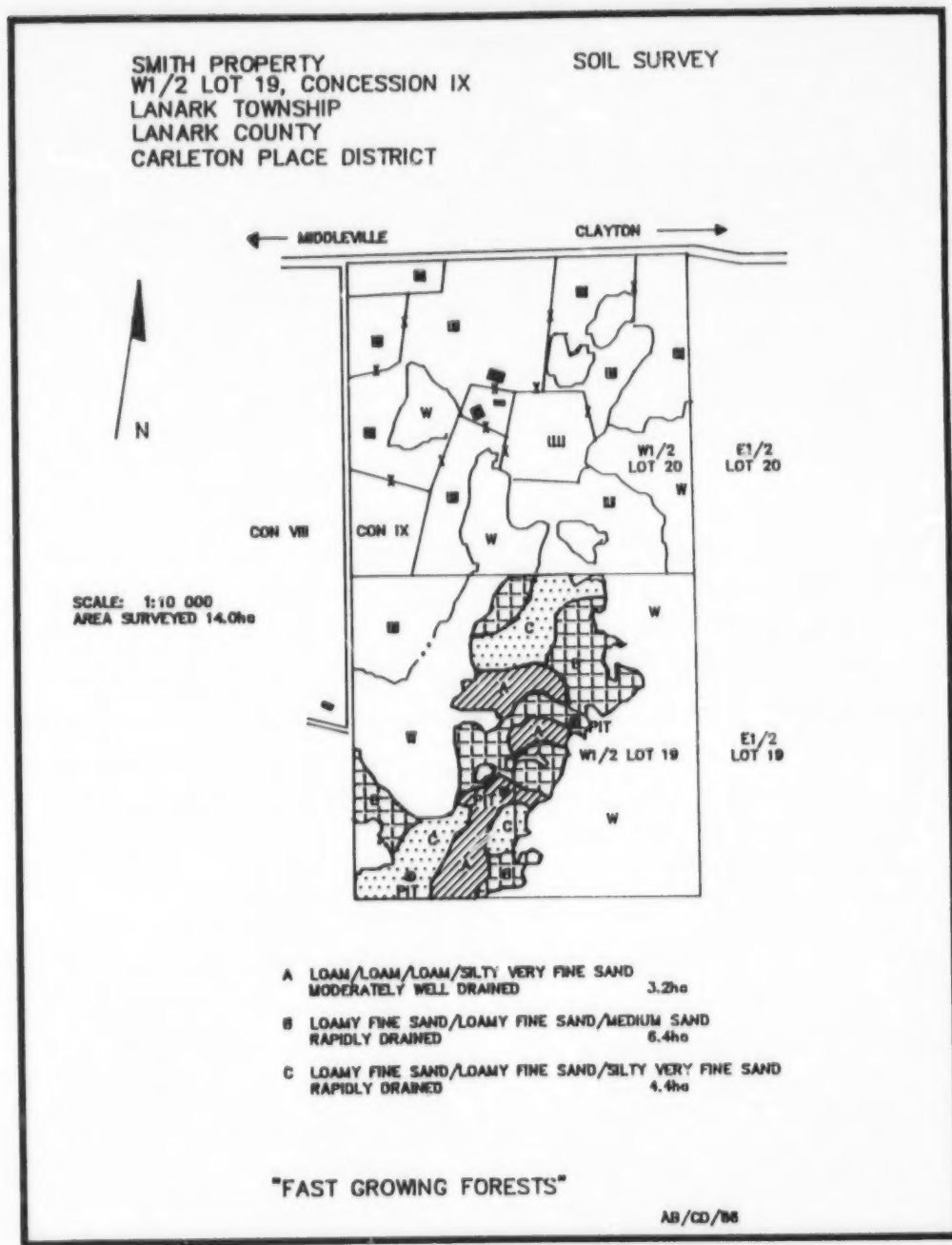


Figure 3 Computerized Compartment File

HORIZONS

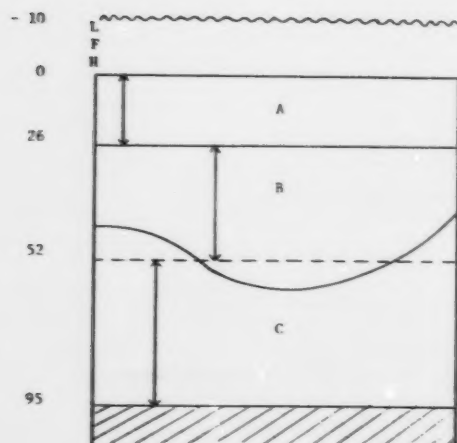
A soil type usually consists of a number of horizons (commonly three) which are differentiated on the basis of texture, coarse fragments, mottling and colour. Each main class of mineral soil horizon is alphabetically labelled in successive order from the soil surface, beginning with the A horizon.

Horizon Depth

The depth of each mineral horizon, beginning with the A horizon, is measured to the nearest centimeter (e.g., A - 0-26 cm, B - 26-52 cm, etc.). If the horizon boundary is wavy, irregular or broken, the measurement is taken at the midpoint between the boundary's upper and lower limits.

Where applicable the depth of the organic material (excluding the Ah horizon, which is a mineral soil horizon) above mineral soil is recorded.

The depth to bedrock is recorded on the soil profile diagram.



Organic Matter Depth: 10 cm

A Horizon 0-26 cm

B Horizon 26-52 cm

C Horizon 52-95 cm

Depth to Bedrock: 95 cm

Figure 4 Horizon Depth Measurements

FOREST HUMUS FORM

On lands previously used for agriculture there is usually only a thin surface organic layer, and no description of organic matter is needed. However, on forested sites, a basic description of organic matter form and depth is required to assess nutrient cycling rates, the potential for establishment of natural regeneration, and requirements for mechanical site preparation.

If the depth of organic matter over mineral soil is less than 40 cm, four classes of humus form are identified: Peaty Mor, Mull, Mor and Moder (see Figure 5). The following organic matter layers must be identified to define forest humus form:

- 1) L, F, H: organic horizons developed primarily from the accumulation of leaves, twigs and woody materials; usually on well to imperfectly drained sites (moisture regime ≤ 5) (Timmer and Palic, 1983); approximately 30% or greater organic matter by weight.

L: characterized by an accumulation of organic matter in which the original structures are easily discernible.

F: characterized by an accumulation of partly decomposed organic matter; some of the original structures difficult to recognize.

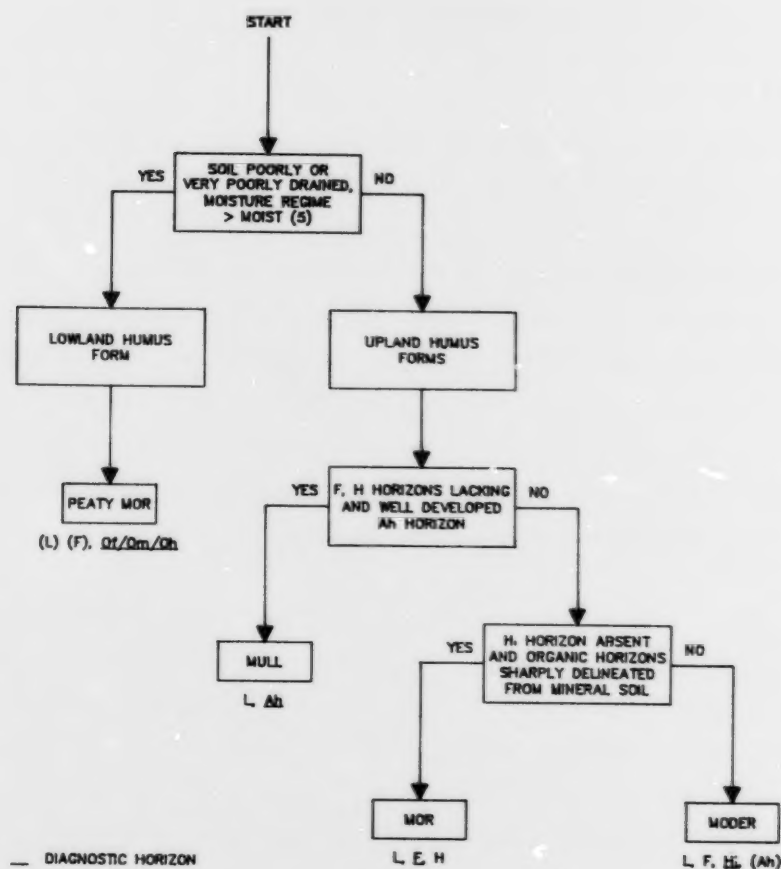
H: characterized by an accumulation of decomposed organic matter in which the original structures are indiscernible; differs from the F layer by having greater humification.

Hi: an organic horizon, characterized by a loose intermixing of organic granules (soil fauna droppings) and mineral particles; the mineral particles appear as loose grains in the organic material; an intermediate stage between an H and an Ah horizon.

- 2) Ah: a mineral horizon enriched with organic matter; a dark grey to black, crumbly mass; approximately less than 30% organic matter by weight.

Source: Ontario Institute of Pedology, 1982

Based on the presence or absence of these organic layers, the humus form is classified (see Figure 5). The description of soils with organic matter depth of greater than 40 cm is discussed on page 12.



1. PEATY MOR

- Gradual transition of organic matter to mineral soil
- Slow rates of nutrient cycling
- Typical Site - poorly drained lowland

2. MULL

- Gradual transition from Ah to lower mineral soil horizons
- Intimate mixture of humus and mineral soil (Ah)
- Plentiful soil fauna
- Rapid rates of nutrient cycling
- Typical Site - abandoned agricultural land or pure hardwood overstory

3. MOR

- Organic matter sharply delineated from mineral soil
- F and H layers interwoven with fungal hyphae
- Minimal soil fauna
- Slow rates of nutrient cycling
- Typical Site - upland, pure conifer overstory

4. MODER

- Properties are intermediate between a Mor and Mull
- Partial mixing of organic matter and mineral soil (H)
- Some soil fauna
- Intermediate levels of nutrient cycling
- Typical Site - moist sites, mixed wood overstory

Figure 5 Humus Form Classification (Organic Matter Depth ≤ 40 cm).
Source: Canada Committee on Land Resource Services, 1982;
Jones et al., 1983

ORGANIC SOILS

Note: This section is only used for the assessment of organic soil types (organic matter depth is greater than 40 cm).

The degree of decomposition of organic material in deep organic soils is classified according to the description below. The identification of these classes is based on the extent of decomposition of plant material and characteristics observed when a sample of organic material is squeezed within the closed hand (the Von Post scale of decomposition (Jones et al., 1983)). The Of, Om, and Oh organic horizons have developed mainly from mosses, rushes and woody material (approximately 30% or greater organic matter by weight).

Of: (fibric) - contains undecomposed or weakly decomposed plant material (plant structures are unaltered or distinct)
- water is clear, light yellow brown to strongly turbid, brown
- no peat escapes between the fingers.

Om: (mesic) - contains moderately decomposed plant material (plant structures are clear but becoming indistinct)
- water is strongly turbid, brown
- up to 1/3 of the peat escapes between the fingers.

Oh: (humic) - contains well decomposed plant material (plant structures are indistinct to unrecognizable)
- water is strongly turbid, brown
- more than 1/3 of the peat escapes between the fingers.

Source: Jones et al., 1983;

Ontario Institute of Pedology, 1982

The total depth of organic matter and depth of each class (if more than one class is present) are recorded.

TEXTURE

Texture is an important characteristic of the soil. It affects water retention and movement, aeration, and soil fertility (although past land use practices may greatly alter these characteristics regardless of soil texture). Texture is determined for each horizon.

The soil proper (i.e., mineral soil) is composed of mineral particles that are 2.0 mm or less in diameter. Soil particle sizes are divided into three classes as shown below:

Sand	2.0 mm - 0.05 mm
Silt	0.05 mm - 0.002 mm
Clay	< 0.002 mm

The relative abundance of the particle size classes determines the soil texture.

For texture descriptions of sand, loamy sand, silty sand and sandy loam, the size class of the sand particles is also described using the categories found below:

Very Coarse Sand	2.0 mm - 1.0 mm
Coarse Sand	1.0 mm - 0.5 mm
Medium Sand	0.5 mm - 0.25 mm
Fine Sand	0.25 mm - 0.10 mm
Very Fine Sand	0.10 mm - 0.05 mm

Field Identification of Soil Texture

There are four field tests that assist in the determination of soil texture: feel, ribbon, moist cast and shine.

Large foreign particles should be removed from the soil sample when evaluating soil texture. Foreign particles include organic matter, roots, shells and coarse fragments greater than 2.0 mm in diameter. This foreign matter could affect the results of the field texture tests.

Organic matter often forms a significant component of soil, particularly in the A horizon, and affects the results of the field tests. It imparts a greasy feel to the soil. If required, the organic matter can be removed by rubbing the soil in the palm of the hand. The component of the sample which adheres to the palm of the hand is largely organic matter and should be discarded.

For the moist cast and ribbon tests, the soil sample must contain a standardized amount of water. The sample should be moist but not wet. A wet soil will leave a water imprint on the hand or stick excessively to the fingers, while a dry soil will exhibit surface cracking. Either extreme will result in altered values for the two tests, so it is important to add or remove water as necessary.

Feel Test

Each of the three soil particle types has a characteristic feel. Sand has a grainy feel, silt a floury feel and clay a very smooth feel. The feel test is the first texture test performed on a soil sample. The soil is rubbed between the thumb and forefinger to obtain a first approximation of mineral particle composition. If necessary, the amount of sand, silt and clay can be estimated using a sample which has been dried out by continuously rubbing the soil in the palm of the hand.

Ribbon Test

Moist soil is kneaded in the hand, rolled into the shape of a cigarette and squeezed between the thumb and forefinger forming the longest, thinnest ribbon possible. The ribbon should be no thicker than 1.5 mm. The greater

the percent of small soil particles (i.e., clay particles) the longer and thinner the ribbon will be.

Moist Cast Test

This test measures the degree to which soil particles cling together when a handful of moist soil is clenched once. If it is found that the soil clings together in a cast, the soil is then worked in the hand to determine to what degree it can be handled. Sand will not form a cast. Silt will form a weak cast. Clay forms a strong cast.

Shine Test

The shine test is performed by rolling some soil into a ball and rubbing it against a hard smooth surface (e.g., a knife blade). As the proportion of clay in a soil increases, so also does the degree of shine. Therefore, this test provides an estimate of clay particle content in the soil.

Field tests for soil texture are subjective and are therefore based to a certain extent on personal interpretations. To minimize personal biases, the surveyor should use all available tests, and periodically compare results with a partner or samples of known texture. For the best results from field texture tests, there is no substitute for practice.

Identifying Characteristics of Texture Classes

Soil texture is defined by the relative proportions of each particle size, as measured on a dry weight basis. Each soil texture is recognized by certain characteristics which are explained in the following (O.M.N.R., 1983):

Sand: (85 - 100% sand, < 15% silt, < 10% clay)

Sand has a grainy feel with no floury material. A cast or ribbon will not form.

Loamy Sand: (70 - 90% sand, < 30% silt, < 15% clay)

Loamy sand has a slight amount of floury material, but is predominantly grainy. There is a very weak cast which does not tolerate handling. Loamy sand will not ribbon.

Silty Sand: (43 - 78% sand, 15 - 50% silt, < 7% clay)

Silty sand has a grainy feel with a considerable amount of floury material. A weak cast can be formed which does not allow handling. Silty sand will not ribbon.

Sandy Loam: (52 - 85% sand, < 40% silt, 7 - 20% clay)

Like silty sand, sandy loam has a grainy feel with a considerable amount of floury material that forms a weak cast. Sandy loam allows careful handling, but when tossed from hand to hand it crumbles. Sandy loam will not ribbon.

Loam: (23 - 52% sand, 28 - 50% silt, 7 - 27% clay)

Loam has a distinctive soft and smooth feel with evident graininess. It forms a good cast that is readily handled and does not crumble when tossed from hand to hand. This soil barely begins to ribbon.

Silt Loam: (< 50% sand, 50 - 88% silt, < 27% clay)

Silt loam has a floury feel with a slight amount of graininess. It forms a cast which allows careful handling. This soil flakes when the ribbon test is performed.

Silt: (< 20% sand, 80 - 100% silt, < 12% clay)

Silt feels very floury. It has a weak cast that allows careful handling. Silt will flake rather than ribbon. When dry, silt particles form a whitish-grey powder residue on the hands which is easily removed by clapping one's hands together.

form a whitish-grey powder residue on the hands which is easily removed by clapping one's hands together.

Sandy Clay Loam: (45 - 80% sand, < 28% silt, 20 - 35% clay)

The feel test reveals a very substantial graininess. A moderate cast can be formed which can be tossed from hand to hand without crumbling. A thick and short ribbon less than 3 cm in length can be produced. It is slightly shiny.

Clay Loam: (20 - 45% sand, 15 - 35% silt, 27 - 40% clay)

A clay loam has moderate graininess and a strong cast. With the ribbon test a fairly thin ribbon can be produced; however it will barely support its own weight and breaks readily. It is slightly shiny.

Silty Clay Loam: (< 20% sand, 40 - 73% silt, 27 - 40% clay)

Silty clay loam has a smooth and floury feel that reflects its mainly silt and clay composition. It forms a ribbon that is fairly thin, breaks readily and barely supports its own weight. It is slightly shiny.

Sandy Clay: (45 - 65% sand, < 20% silt, 35 - 55% clay)

A substantial amount of sand is present even though the clay is the dominant component. The feel test clearly reveals sand to be present. A strong cast is associated with this soil texture. The ribbon test produces a fairly long (5 - 7.5 cm) and thin ribbon that can hold its own weight. It is moderately shiny.

Silty Clay: (< 20% sand, 40 - 60% silt, 40 - 60% clay)

Silty clay has a smooth feel. It forms a very strong cast which reflects its small particle composition. A thin, fairly long (5 - 7.5 cm) ribbon that holds its own weight can be formed. It is moderately shiny.

Clay: (< 45% sand, < 40% silt, 40 - 100% clay)

Clay has a smooth feel. The ribbon produced with clay is thin, long (>7.5 cm) and will hold its own weight. The cast produced is very strong and requires some effort to manipulate. This texture is very shiny. When dry, clay particles form a greyish-brown residue on the hands which is difficult to remove.

A key for the field identification of soil texture is found in Figure 6. The soil texture classes are illustrated in the textural triangle (see Figure 7).

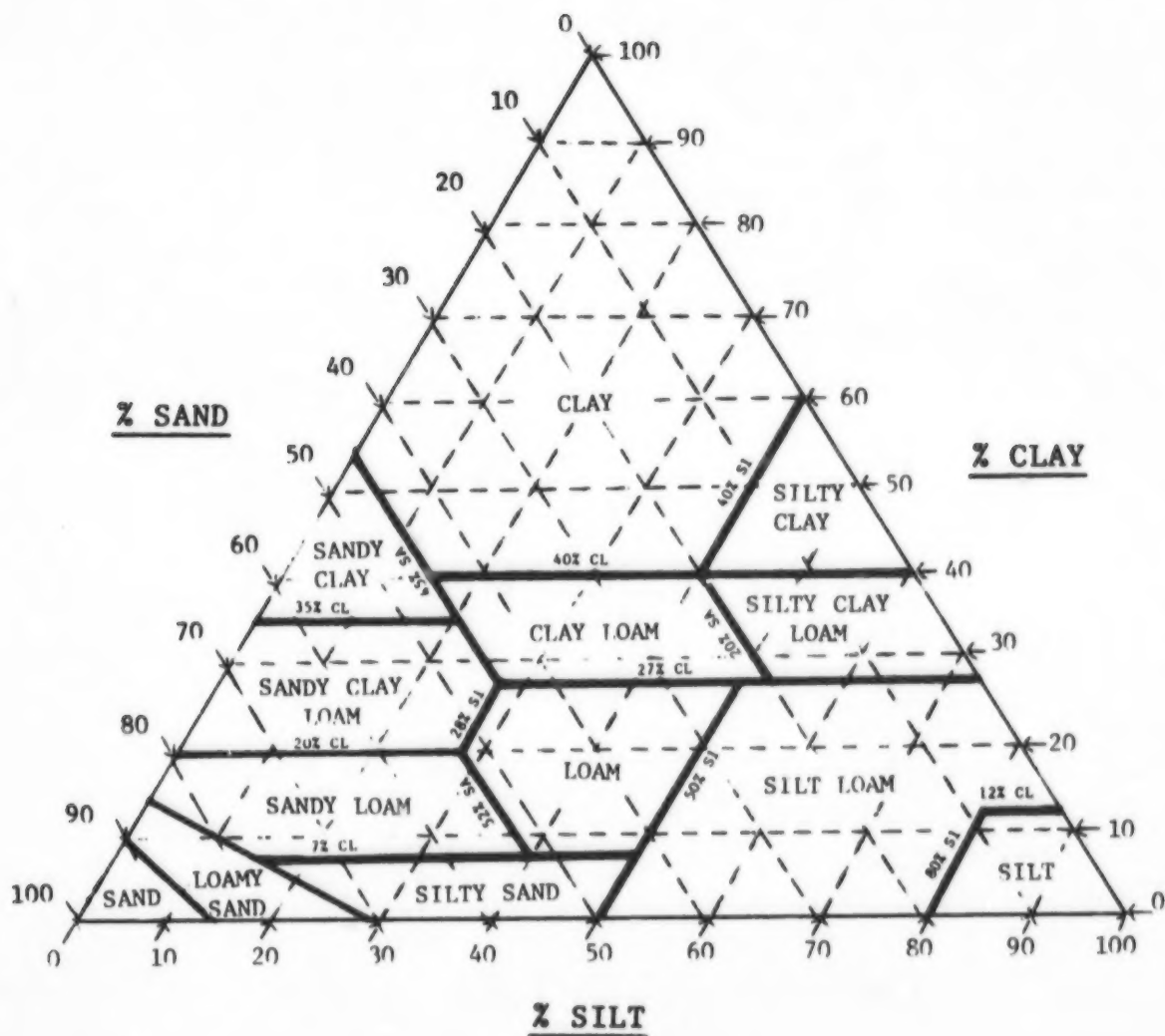


Figure 7 Soil Texture Triangle. Source: Timmer and Palic, 1983

STRUCTURE

Soil structure refers to the aggregation of primary soil particles into peds (Armson, 1977). Peds are defined as individual natural soil aggregates separated from other aggregates by surfaces of weakness (Canada Committee on Land Resource Services, 1982). The structure of a soil affects water movement, aeration, and rooting pattern. The soil structure for each horizon is classified as follows:

Structureless: loose single-grain or massive coherent soil deposits without obvious peds.

Moderately Structured: obvious peds, but few smaller than 10 mm in size.

Well Structured: obvious peds mainly smaller than 10 mm in size.

Source: Pierpoint, 1987

MOTTLES AND GLEY COLOURS

Mottles and gley colours refer to changes in soil colour brought about by water-saturated conditions. The reduction of certain minerals due to these saturated conditions results in a soil with a blue-grey (gley) colour or the presence of grey-yellow-orange-red coloured mottling (Armson, 1977). The presence of gley colours indicates a longer period of water saturation.

Mottles must be distinguished as being either distinct or prominent. These classifications are defined with a Munsell Soil Color Chart* as illustrated below.

Class	Description	Dissimilarity of Mottle Colour from Soil Colour in Munsell Units		
		<u>Hue</u>	<u>Value</u>	<u>Chroma</u>
Distinct	Mottles can be recognized but are similar in colour to the surrounding soil	2.5	1	1
Prominent	Mottles are substantially different in colour compared to the surrounding soil	5.0	3	3

Gley colours are defined as follows (chroma and hue values may be found in Munsell Soil Color Charts):

- chroma ≤ 1 ; any hue,
- chroma ≤ 2 ; hues 10YR or redder,
- chroma ≤ 3 ; hues yellower than 10YR,
- any chroma; hues bluer than 10Y,
- any chroma; reddish hues.

Source: Ontario Institute of Pedology, 1982

*Munsell Soil Color Charts, Munsell Color Co. Inc., Baltimore, Maryland,

Note: The natural colour of certain sandy soils may satisfy the previous criteria. A consideration of mottling, soil moisture and vegetation is required in this exception to assess if true gley colours are present.

The distance from the top of the mineral soil to the top of the zone where (and if) distinct mottles, prominent mottles, or a gley layer occur, is recorded.

Note: Do not record mottles if they are faint or occupy less than 2% of the soil profile area.

SOIL MOISTURE

Soil moisture is often considered to be the most important factor assessed in a soil survey. Two different systems of assessing soil moisture are employed: drainage and moisture regime.

These two classification systems require an assessment of mottles and gley colours, soil depth, soil texture or family particle size (see Figure 11), slope and soil structure.

Note: The water table level varies substantially with the time of year and weather conditions and may be a misleading indicator of soil moisture conditions. However, the depth to standing water in the soil pit is indicated on the soil profile diagram.

A guide to the figures used for assessing soil moisture (Figures 9 - 13) is found in Figure 8.

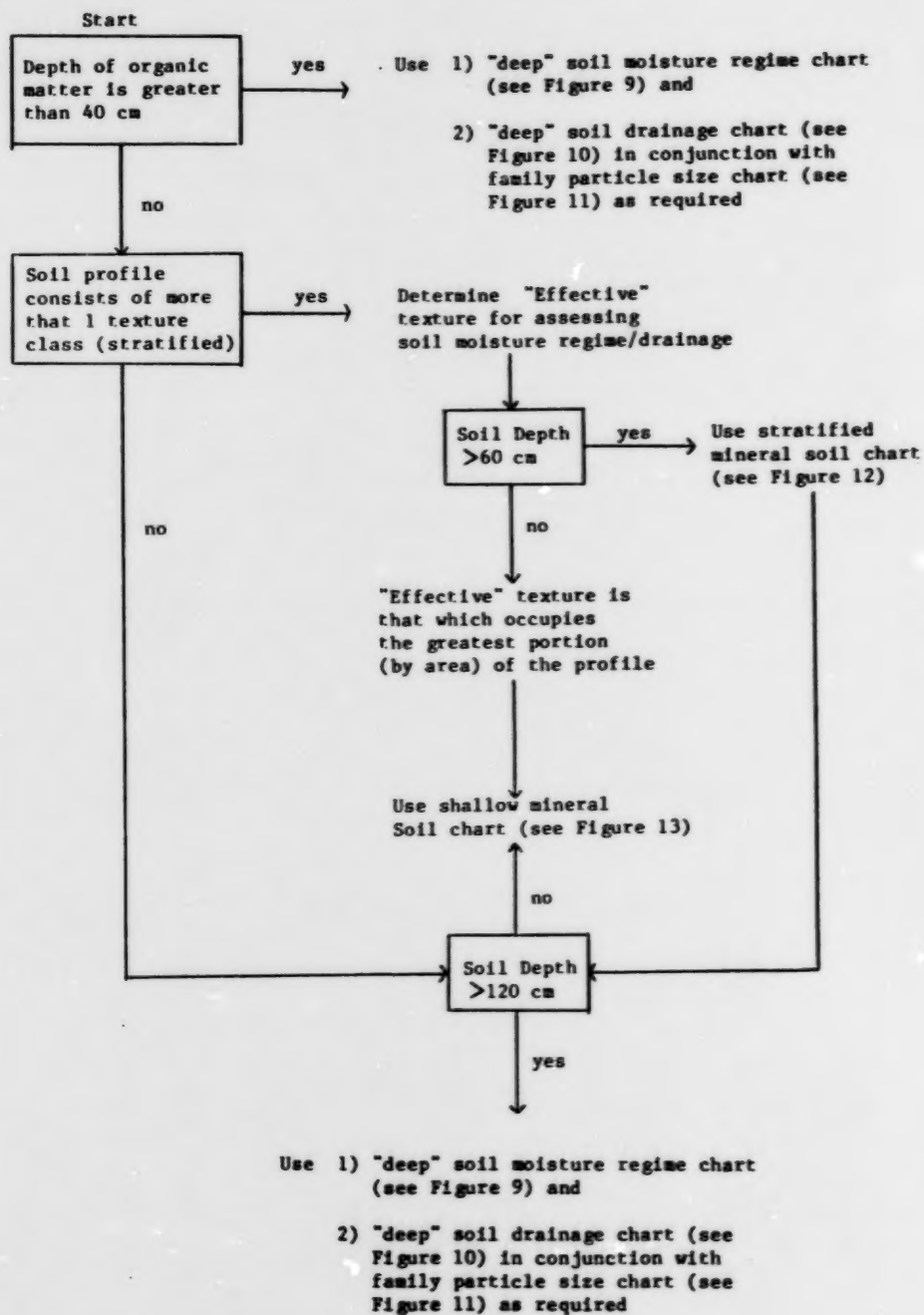


Figure 8 A Guide to Assessing Soil Moisture

DEEP MINERAL SOILS (>120 cm)			SOIL MOISTURE REGIME ³										ORGANIC SOILS ⁴		
PERVIOUSNESS CLASS ¹	PORE PATTERN ¹ of MINERAL SOIL MATERIALS EXAMPLES OF TEXTURES WITHOUT COMPACTION ²	PORE PATTERN CLASS/STN	DRY (d)				FRESH (f)				MOIST (m)				VERY WET
			DRY	MOD. DRY	MOD. FRESH	FRESH	FRESH	VERY FRESH	MOD. MOIST	MOIST	VERY MOIST	MOD. WET	WET	VERY WET	
	ALL MATERIAL > 20 mm	EXTREMELY OPEN	0	0	1	2	3	4	5	6	7	8	9		
RAPIDLY	VERY COARSE AND COARSE SANDS, LOAMY VERY COARSE AND COARSE SANDS	VERY OPEN													
	MEDIUM SAND, LOAMY MEDIUM SAND	OPEN													
	FINE SAND, LOAMY FINE SAND, SILTY FINE SAND	MODERATELY OPEN													
	SANDY LOAM, VERY FINE SAND, LOAMY VERY FINE SAND, SILTY VERY FINE SAND	MODERATELY RETENTIVE													
MODERATELY	LOAM, SILT LOAM, SANDY CLAY LOAM, STRUCTURED SILTY CLAY AND CLAY (aggregates < 10 mm)	RETENTIVE													
	SILT, SILTY CLAY LOAM, CLAY LOAM, SANDY CLAY, CLAY, STRUCTURED SILTY CLAY AND CLAY (aggregates > 10 mm)	VERY RETENTIVE													
SLOWLY	STRUCTURELESS SILTY CLAY AND CLAY	MODERATELY RESTRICTED													
	POROUS OR FRACTURED BEDROCK	RESTRICTED TO VERY RESTRICTED													
	NON-POROUS BEDROCK	EXTREMELY RESTRICTED													

Figure 9 Soil Moisture Regime (Deep Mineral Soils). Source: Jones et al., 1983.

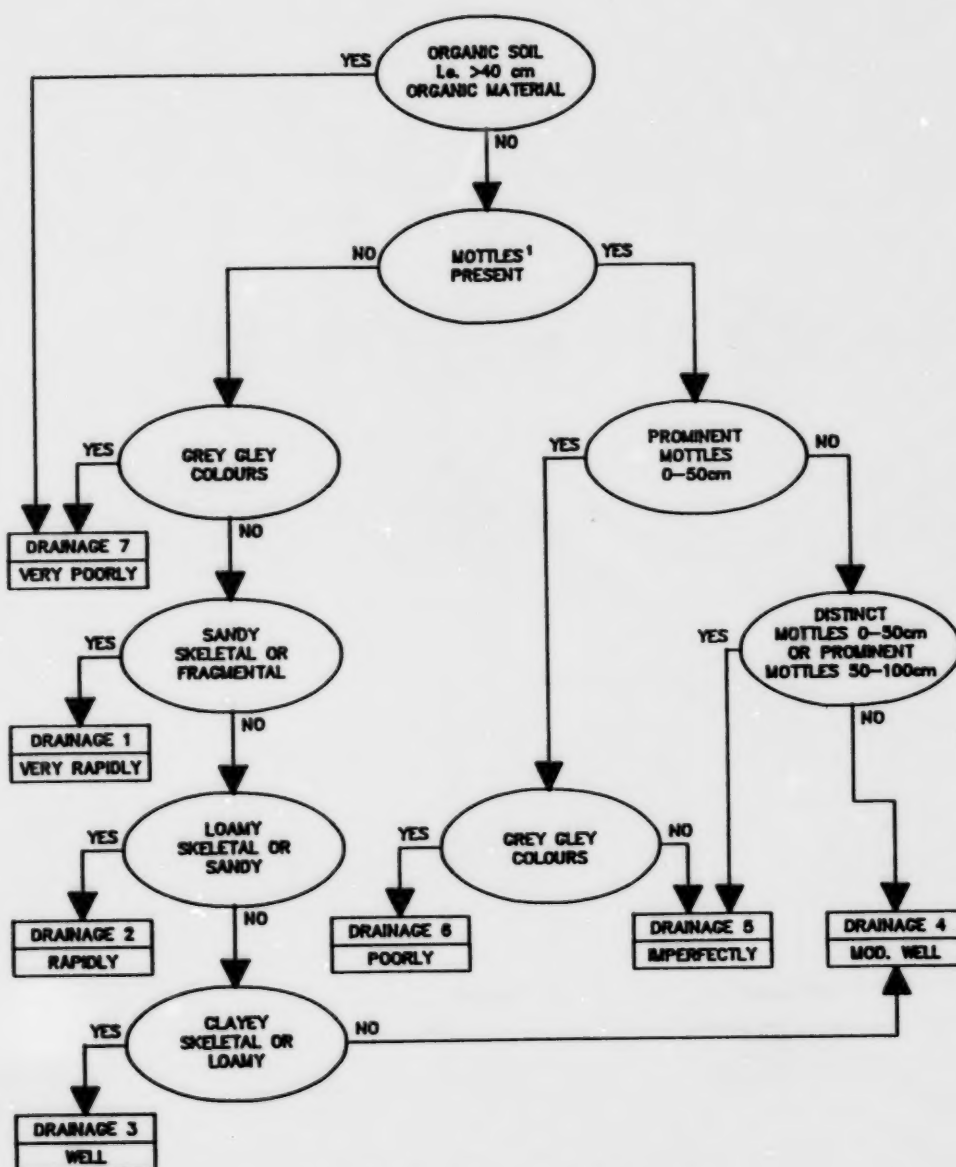


Figure 10 Soil Drainage (Deep Mineral Soils). Source: Ontario Institute of Pedology, 1982

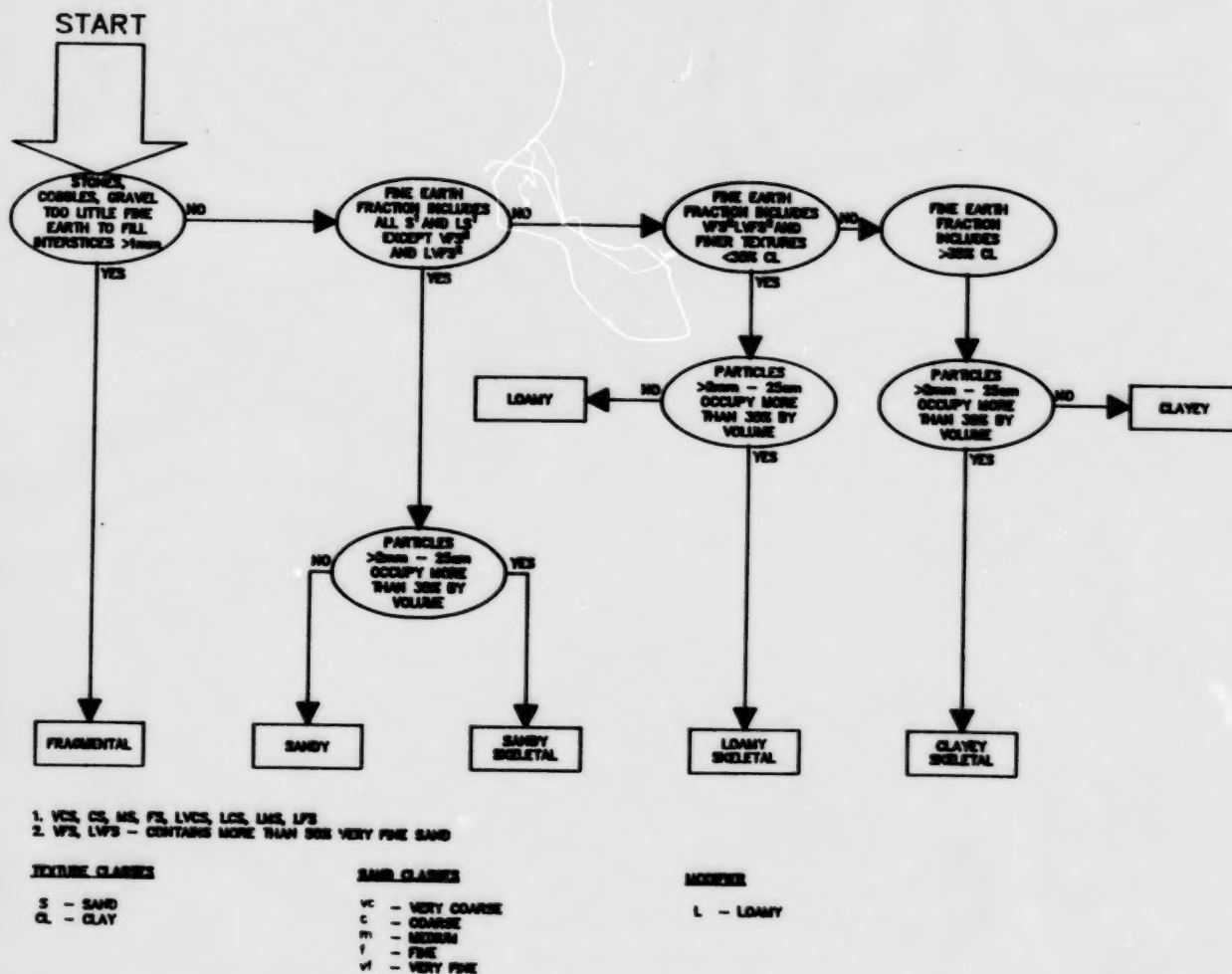
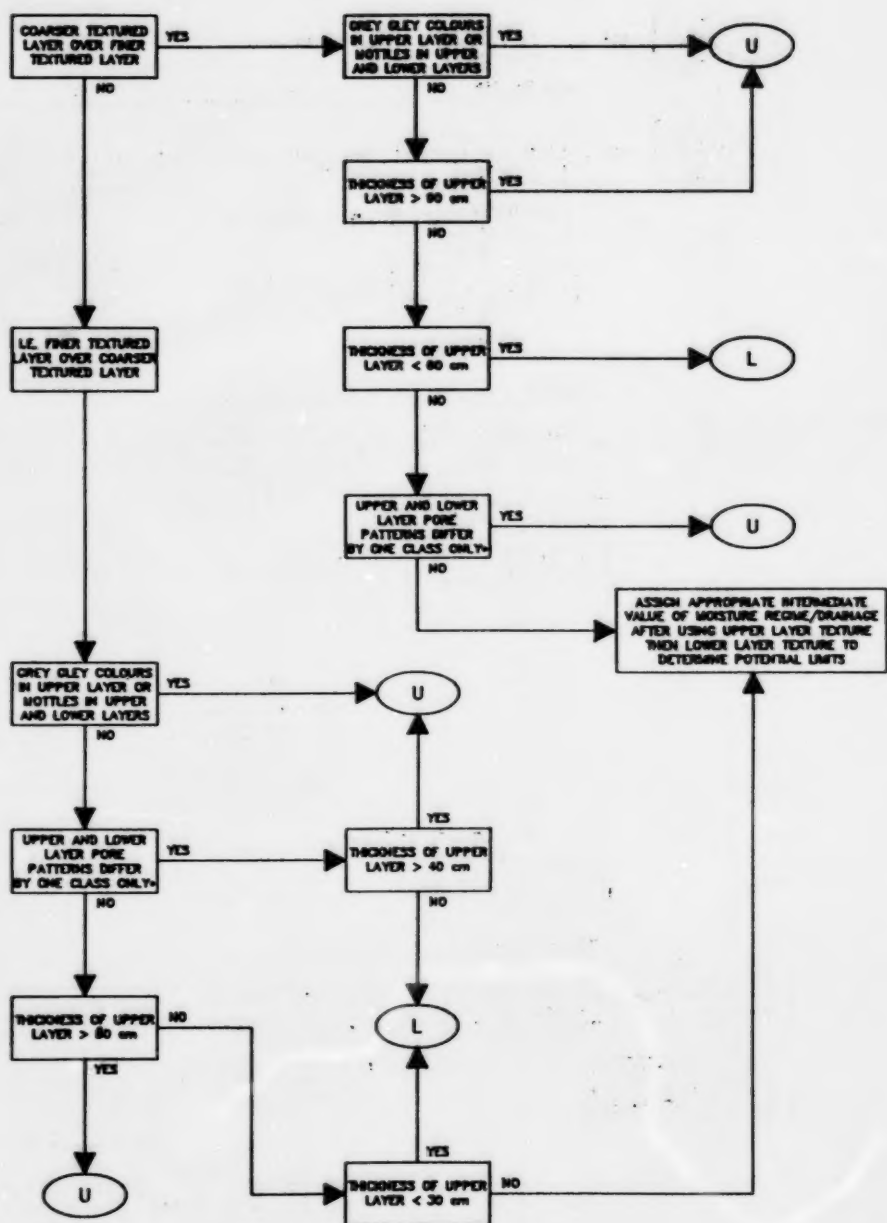


Figure 11 Assessment of Family Particle Size. Source: Ontario Institute of Pedology, 1982



U - USE "UPPER LAYER TEXTURE" TO DETERMINE MOISTURE REGIME/DRAINAGE CLASS

L - USE "LOWER LAYER TEXTURE" TO DETERMINE MOISTURE REGIME/DRAINAGE CLASS

* - FOR PORE PATTERN CLASS REFER TO SOIL MOISTURE REGIME (DEEP MINERAL SOILS, FIGURE 10)

Figure 12 Assessment of Effective Texture in Stratified Mineral Soils (> 60 cm Over Bedrock). Source: Pierpoint, 1987

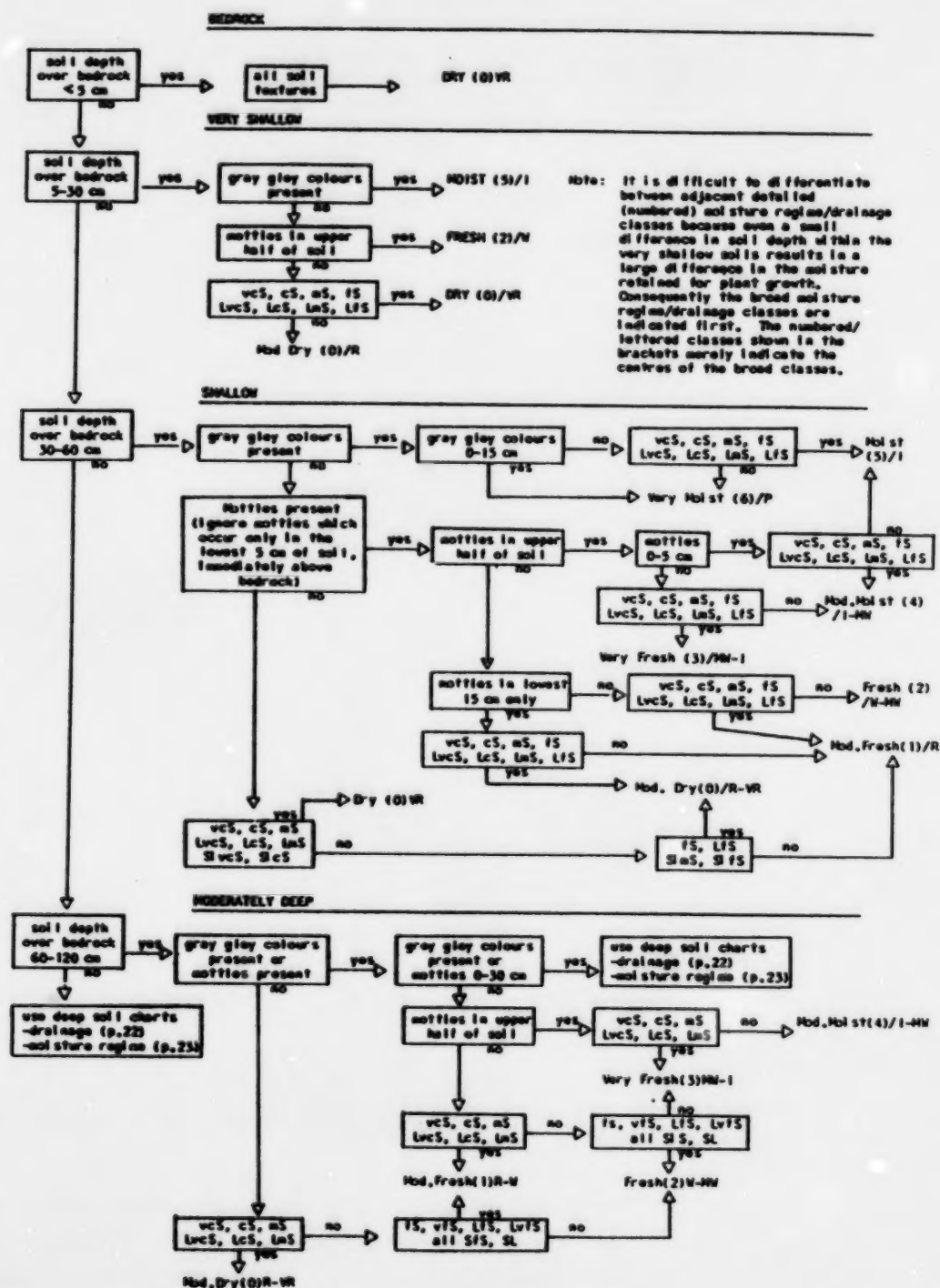


Figure 13 Soil Moisture Regime and Drainage (Shallow Mineral Soils - <120 cm Over Bedrock). Source: Pierpoint, 1987

ROOTS

Root development provides an indication of changes in soil moisture, aeration, and nutrient concentration within the soil profile. The rooting pattern is described for each horizon by noting the average abundance and diameter of roots within a reference unit area (for fine roots, 5 cm x 5 cm (25 cm²) for medium and coarse roots, 20 cm x 20 cm (400 cm²)).

Abundance:

few	< 3 per unit area
plentiful	3 - 25 per unit area
abundant	> 25 per unit area

Diameter:

fine	< 2 mm
medium	2 - 5 mm
coarse	> 5 mm

The major species of vegetation and maximum rooting depth (from the top of the mineral soil) are also recorded.

COARSE FRAGMENTS

The degree of stoniness affects root penetration, soil aeration, soil fertility and soil drainage. As well, an estimate of stoniness is essential for operations planning. Coarse fragments are described according to their abundance and size on a horizon basis. The chart below lists the various classes for the fragment names and abundance.

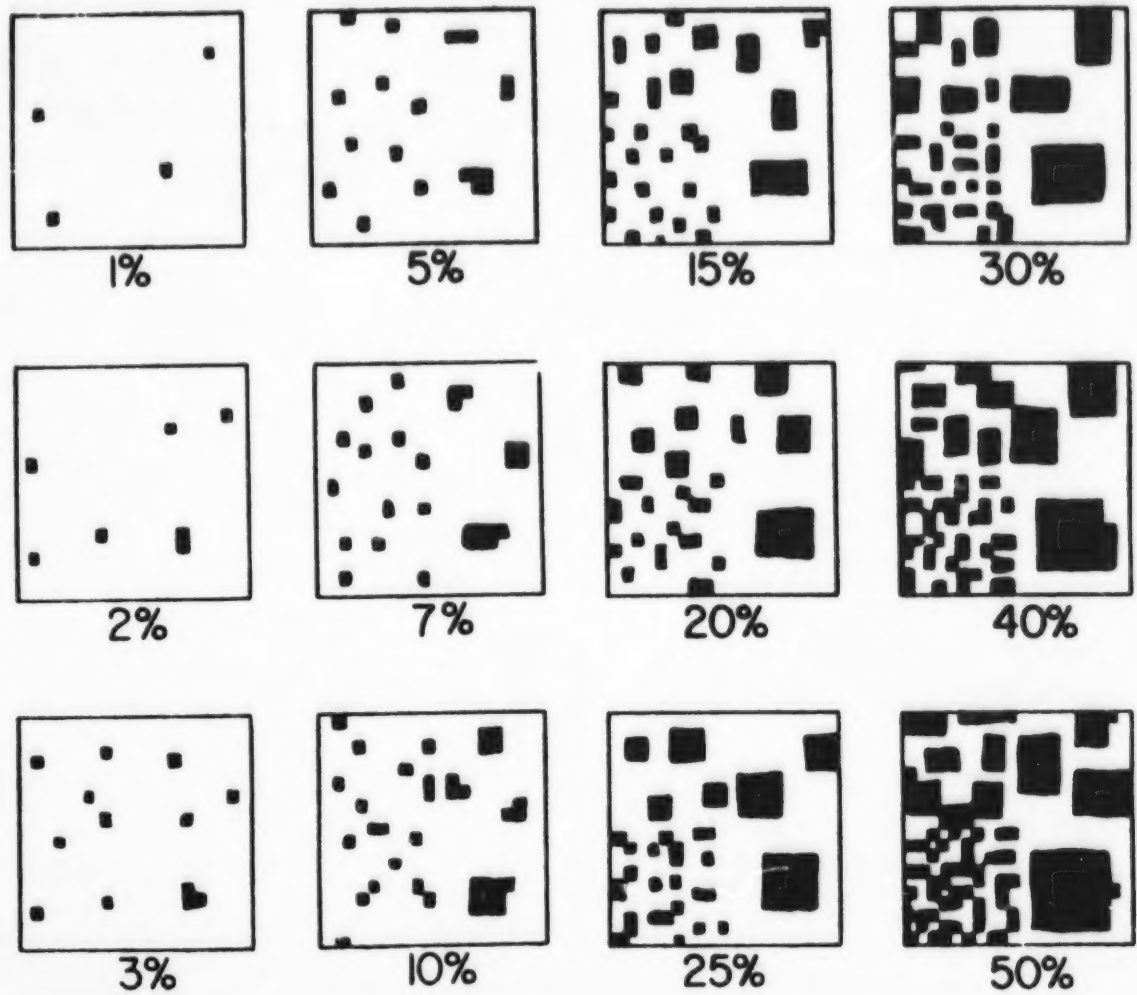
<u>Fragment Name</u>	<u>Size (cm diameter)</u>
gravel	0.2 - 7.5
cobble	7.5 - 25
boulder	> 25

<u>Abundance</u>	<u>Area (%)</u>
very few	1 - 20
few	20 - 35
common	35 - 50
many	> 50

The percentage of coarse fragments may be estimated using Figure 14. The abundance of exposed bedrock is recorded as a percentage of surface area.

FREE CARBONATES

The presence of free carbonates in the soil affects tree nutrition. The distance from the top of the mineral soil to the point where an effervescence is observed when a few drops of 10% HCl solution are applied to the soil profile is recorded.



Each fourth of any one square has the same amount of black

Figure 14 Area Percentage Chart. Source: Timmer and Palic, 1983

FINAL SOIL SURVEY REPORT

The final soil survey report consists of a soil profile description sheet for each pit, and a final soil survey map drafted at a scale of 1:10 000.

The following information appears on the final soil survey map:

- Title,
- Scale,
- Area,
- North Arrow,
- Property Name,
- Lot and Concession,
- Township,
- Administrative District,
- Date Drafted,
- Access,
- All property features,
- Soil type delineations,
- Soil pit locations and numbers,
- Soil type description.

Maps should be produced so that the north arrow points to the top of the page.

The map symbols illustrated in Figure 15 are used to distinguish property features.

Lot or Concession Boundary

Road

Trail

Forest Access Road

Bridge

Building (house, etc.)

Foundation

Town

Radio Tower

Hydro Lines

Fence Lines

Railway Lines

Pipeline

Telephone Lines

Highway, Powerline, Pipeline, Right of Way

Township Boundary

Quarry

Private (Patented) Land

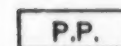
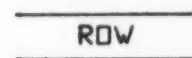
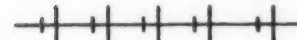
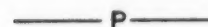
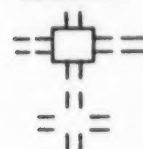
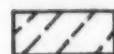
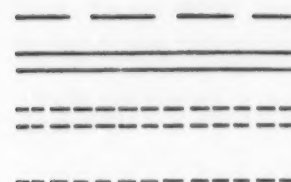
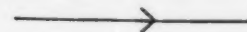
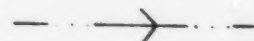


Figure 15 Map Symbols

Stream, Ditch, Creek
(With Direction of Flow)



Seasonal Stream
(With Direction of Flow)



Brush and Alder



Swampy or wet Area



Flooded Land

F.L.

Rockland

R.L.

Developed Agricultural Land

D.A.L.

Open Land, Rough Pasture, Grassland



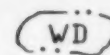
Vegetation Boundary



Plantation

P.L.

Wooded (forest type boundary)



Tree Species (Red Pine)

Pr

Single Tree



Rock Pile



Soil Pit



Soil Type Boundary



North Arrow



Figure 15 Map Symbols (cont'd)

EQUIPMENT

The following is a list of equipment necessary to carry out this soil survey.

<u>Quantity</u>	<u>Equipment</u>
1	Soil Survey Standards manual
1	Shovel
1	Trowel
1	Pocket knife
1	Meter stick or measuring tape (minimum 1 m long)
1	Clip board with soil profile description sheets
1	Water bottle
1	Eyedropper bottle with 10% HCl solution

The following optional items may also be included:

<u>Quantity</u>	<u>Equipment</u>
1	Soil auger
1	Munsell Soil Color Chart

REFERENCES

- Armson, K. A. 1977. Forest Soils: Properties and Processes. University of Toronto Press, Toronto. 390 pp.
- Brady, N. C. 1984. The Nature and Properties of Soils. 9th Ed. MacMillan Publishing Co. New York. 750 pp.
- Canada Committee on Land Resource Services, Subcommittee; Expert Committee on Soil Survey, J. H. Day, ed. 1982 Revised. The Canada Soil Information System (Can SIS). Land Resource Research Institute Contribution No. 82-52. Agriculture Canada, Ottawa. 97 pp.
- Jones, R. K., G. Pierpoint, G. M. Wickware, J. K. Jeglum, R. W. Arnup, J. M. Bowles. 1983. Field Guide to Forest Ecosystem Classification For The Clay Belt, O.M.N.R., Toronto. 161 pp.
- Munsell Color Co. Inc. 1975. Munsell Soil Color Charts. MacBeth Division of Kollmorgen Corporation, Baltimore, Maryland.
- Ontario Institute of Pedology. 1982. Field Manual for Describing Soils, 2nd Edition. Ontario Institute of Pedology, Publication No. 82-1. University of Guelph, Guelph.
- Ontario Ministry of Natural Resources; Fast Growing Hardwoods Group. 1984. Soils: The Foundation of New Forests in Ontario. Brockville. 76 pp.
- Ontario Ministry of Natural Resources; Northeastern Region. 1983. Northeastern Region Forest Land Productivity Survey (F.L.a.P.S.). Sudbury. 37 pp.

Pierpoint, G. 1987. Physical Site Description in the Field (Draft Version)
O.M.N.R. Mensuration Unit. Timber Sales Branch, Toronto. 12 pp.

Pritchett, W. C. 1979. Properties and Management of Forest Soils.
John Wiley and Sons, New York. 500 pp.

Timmer, V. R. and M. E. Palic. 1983. Forest Soils. Laboratory Manual.
Faculty of Forestry, University of Toronto, Toronto. 103 pp.